Physical computing from Scratch using scratchClient – **Expert**

Control servos, LEDs and more from Scratch using RPi, Arduino, scratchClient

Hans de Jong & Gerhard Hepp

Workshop for the Pi And More and Maker Faire conferences

Need to be updated in many parts

Part 1: Strongly link the config file to the Arduino

The ident functionality

- You created a board, but maybe you have omitted some resistors and therefore damage would occur if it were used with the wrong config file.

- That is what the ident functionality is for
  - Configure an identity in the Arduino
  - Specify the identity in the config file

Programming the ident in the Arduino

- Have the Arduino connected
- Start the Arduino IDE
- Go to monitor mode
- Set the speed to *115200*
- Set the line end to *newline*
- You can now type commands in the window.
- Type:
  - *cident:PiAndMore10*
  - *cident?*   (you should get the string back)
- Put in the config tool the value *PiAndMore10* in the field *Parameter ident.pattern*

Testing ident functionality

- Start scratchClient and see that it works
- Now change the value of the ident in the config file.
  - Hardly matters what
- Start scratchClient again and see that it will be rejected

More about ident

- The ident can in the config file be specified as a regular expression. E.g.:
  - A dot (.) matches any character
  - A star (*) repeats the previous character (0 or more times)
  - If you want to know more about regular expressions, see e.g. http://www.rexegg.com/regex-quickstart.html
- So you could specify
  - PiAndMore.* and it would work when PiAndMore9, PiAndMore10 or PiAndMore100 is programmed in the ident of the Arduino
- Ident is also needed to identify a specific Arduino if multiple will be connected concurrently (see next slides).

Part 2: Controlling multiple Arduinos

Control multiple Arduinos

- Running out of pins on one Arduino? Connect more of them!
- The /dev/ttyUSBnn port in the config file will define which part of the configuration is used for which Arduino.
- Using the ident functionality (see previous topic) can be used to check that the correct Arduino was connected to the intended port.
  - You can get the Arduinos on the correct ports by connecting them always in the same sequence.

Creating a config file for multiple Arduinos

- First create two separate config files for each Arduino and test them out.
  - The config tool can only work on a single adapter at a time.
- Now create a new .xml file, and
  - Copy in the first file completely
  - Take the adapter section (most of the file) of the second file and paste this after the first adapter
  - Adapt the USB port in one of the files (make the board that you connect last /dev/ttyUSB*1*.

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Trying it out – merge and config

- Take the Weekendschool board with the Duck
- Test it out with the config file and the Scratch program
- Merge the two files in the way described.
  - Make the Weekendschool board /dev/ttyUSB*1*.
- Disconnect both boards.
- Restart scratchClient with the merged file.
- Connect the workshop board first. It will become /dev/ttyUSB*0*.
- Connect the Weekendschool board second. It will become /dev/ttyUSB*1*.
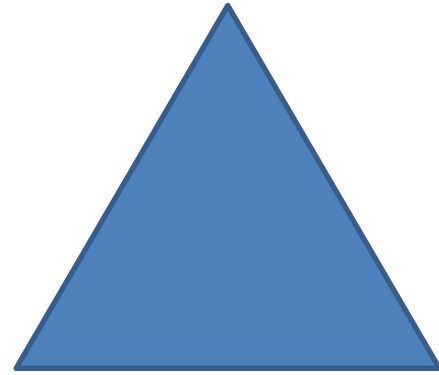
Trying it out – Control from Scratch

- In the Scratch program of the workshop, define these variables
  - Tiltservo
  - Panservo
- Try giving them values between 0 and 100 with the slider on the variable.
- Does the duck tilt and pan?
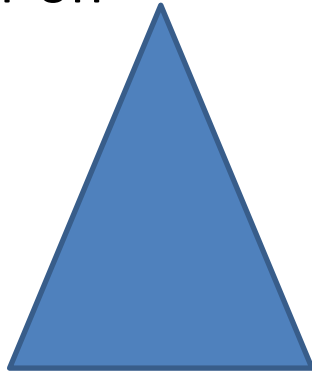
Making the /dev/ttyUSBnn not matter anymore

- In the way described before, the Arduinos must be connected in a specific sequence
- You can alternatively use a program that will
  - Look at the connected boards (using the ident string)
  - Give a selection option to start with config files for which all the boards are present.

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Explaining the startup tool
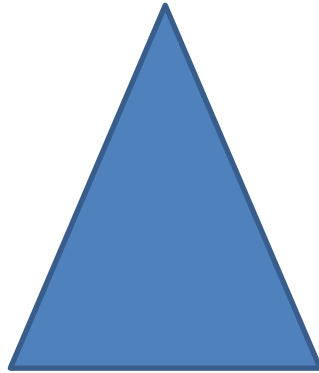
Power on self test (POST)

Power on self test (POST)

- See the Weekendschool board with the duck.

- When setting up the lesson, one wants to be able to quickly see whether the board works correctly.

- Also, when the boards have to be packed, the duck should bow deep to make sure it fits in the box.
  - Moving servos by hand is not preferred.

- The scratchClient Arduino sketch has a place where you can insert your own code to realise this functionality.

How to do the POST?
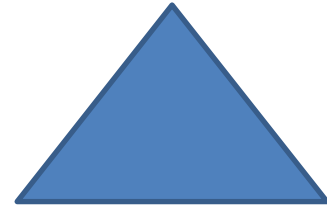
- You will need to address the pin numbers directly. You **cannot** make use of the config file of scratchClient.
- See the Arduino sketch of the Weekendschool board.
  - Between the xxxx and yyyy markers
- Now try on the PiAndMore board to lite 3-color LED
  - 0.5 seconds Red
  - 0.5 seconds Green
  - 0.5 seconds Blue
  - 0.5 seconds White
- Load the sketch in the board and look whether it works.

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Controlling a relay

Controlling a relay

- Controlling a relay like controlling a LED? NOT a good idea!
- A relay has a coil that stores energy when powered.
  - When breaking the current flow, the voltage over the relay coil can get so high that it destroys the Arduino – and more.
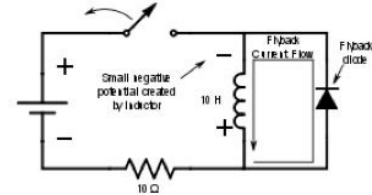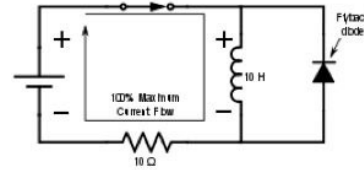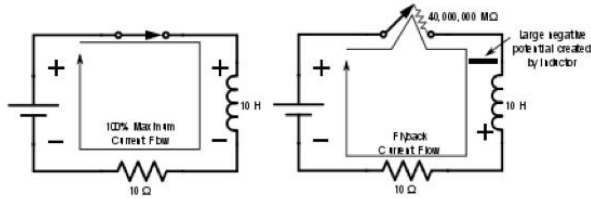
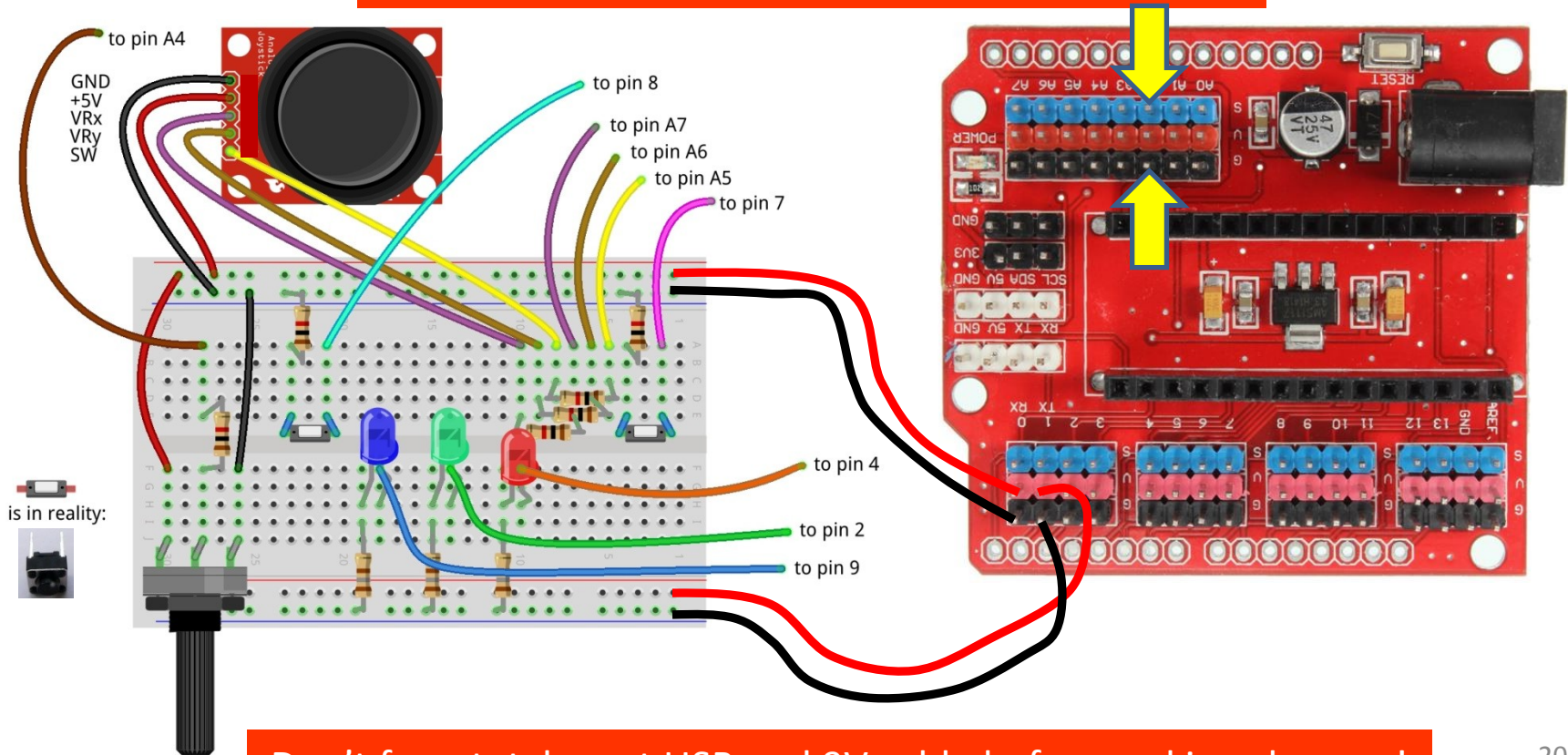- At least a flyback diode should be used.

Other issues – and the solution

- Often the current of the coil will be too high to drive directly from the Arduino
  - So a transistor will be needed.
- Solution
  - Use a relay module with an opto coupler
  - Cost is generally not an issue. The relay module we use here is < € 1.
  - We only have a few relays today, so you will need to share.

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Connect the relay module to pin A2

to pin A4

GND
+5V
VRx
VRy
SW

Analog Joystick

to pin 8

to pin A7
to pin A6
to pin A5
to pin 7

to pin 4

to pin 2

to pin 9

is in reality:

Don't forget: take out USB and 9V cable before making changes!

Use a servo to press buttons on appliances

Safely controlling 220 Volt appliances

- You can in principle use a relay to control 220 Volt appliances.

- However, this is not something you want to do in a classroom situation

- Alternative: use a remote control and use servos to press the buttons.

- See also the next slide.

Controlling a camera

- Use a servo to press the button of the camera
- Cannot do in the workshop
- See the example setup in the workshop

What else can scratchClient do?

Can scratchClient do more? Yes!

- It can also let you configure and use the GPIO pins on the Raspberry Pi itself.
  - However be aware:
    - There is no analog input on Raspberry Pi.
    - The pins are **NOT** 5 Volt tolerant (max 3.3 Volt).
    - The max current per pin on Raspberry Pi is lower than on Arduino.
    - If you blow up an Arduino (clone), the cost is limited to a few euro.
      - A Raspberry Pi is much more expensive.
- scratchClient can also control Sonic Pi for high quality audio.
- There are also Arduino sketches to control LED strips (Neopixel WS2812) and to control LEGO Power.
- scratchClient can work with Scratch 2.0 (soon).
- scratchClient can also run on Windows and then via Arduino control peripherals.
- scratchClient can work with multiple Raspberry Pi configurations in a network.

Take your work home

Do you want to take your work home?

- If you brought your own USB stick, then connect it and copy the *PiAndMore* folder on the desktop
- The rest of the material you can download from www.github.com
- Take the flyer with you to remember where to find the material on github.

Clean up / teardown

Unplug and pack up

- Unplug the board from USB and power it off
- Please remove all components and wires from the **breadboard**
- Remove all wires from the **Arduino board**.
- *Leave* **the wires on the 3 color LED**
- *Leave* **the wires on the buzzer**
- If something is broken, please
  - Throw it away or hand it in (if it is unclear)
  - Put a note in the box that it is missing
  - Do not put anything that is broken back in the box
- Put everything in the box. The board goes on top
- Shutdown the Arduino
- Let us know what you thought about this workshop, now orally or later by email
  - hans.piam@hanselma.nl
  - heppg@web.de

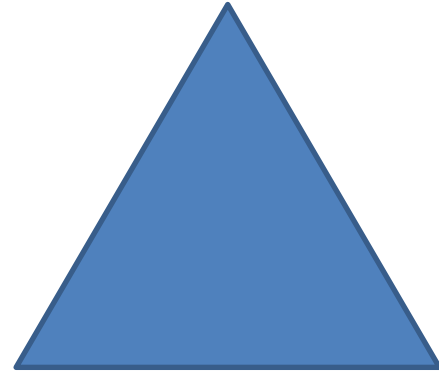Hans de Jong / Gerhard Hepp

End of the Advanced Workshop

Appendix

Maximum current per pin

- Max output current per pin = 20 mA

- Total current for the board: 1 A

- Note that also the potentiometer and the joystick take power
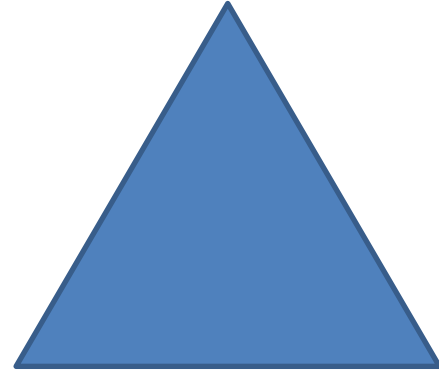
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Calculation of the resistors

Cost of the setup (1 of 2)

- This is a list of the cost of the setup of the external board.
- Not included is the cost of the perspex board and the nuts and bolts, which are not an absolute minimum requirement
  - And for which there are alternatives, e.g. use cardboard or an MDF board
- All material comes from Aliexpress
  - Very cheap
  - Often no shipping costs to Europe
  - Takes between 2 weeks and 2 months
    - Or never arrives, but then money is promptly returned.
  - When ordering below 22 euro, no import duties and handling costs

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Cost of the setup (2 of 2)

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The End